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HEALTH, WELFARE and DEVELOPMENT

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Judged by any standards, we are undoubtedly living in the most exciting period of history the world has known. Before the year 2000 it is confidently expected that atomic energy will be in common use, we may have interplanetary travel, the world will be made, in effect, even smaller than it now is by supersonic air travel, and there will be countless new developments in the natural and social sciences, in engineering and in the humanities. We will find a method of utilizing solar energy, of cultivating the sea to obtain plant food and of treating it economically to obtain an inexhaustible supply of fresh water. The list of possibilities taxes the imagination.

By present indications it is evident that, parallel to these spectacular accomplishments, will be a less spectacular, but more important phenomenon, the rational development of the backward areas of the world. Due to a combination of social, economic and political factors, this development has become internationally important. New techniques in such fields as health, transportation, communications, agriculture and manufacturing, have made it possible, with long-range planning, to improve radically the social and economic status of entire countries and have given the people of these countries new hope and new aspirations for the future. The fact that the United States and the other Great Powers have recognized this desire and that they are actively engaged in programs of global development, may, according to historians, be the most significant event of the twentieth century.

It takes only a brief examination of the question of development to realize that it is a highly complex matter. While there is general agreement regarding the benefits to be derived from the application of modern technology, it requires adaptation to particular conditions and involves such problems as population pressures, the conservation of resources and international politics. The degree of controversy in these matters is indicated by the large number of books and articles which have recently appeared defending one side or the other of the argument.

It is not the purpose of this paper to discuss these problems except incidentally, but rather to emphasize the significance of the present situation to engineers in general and to those engineers engaged in environmental sanitation in particualr. An examination of the historical events leading to our present interest in global development shows that developmental work has been going on for a very long time. It also makes apparent the importance of the contribution which has been made by engineering and medicine. Sanitary engineers have, therefore, not only a particular interest but a definite responsibility in future policies and future plans in connection with health and development.

The so-called backward or underdeveloped areas can best be classified as those which are making ineffective use of their natural resources. While some backward areas have been developed internally most of them were originally developed as colonies, planned to bring the maximum benefit to a mother country. Colonization, besides its immediate effects, also proved to be a powerful factor in the diffusion of culture and in the economic and political integration of the world.

The earliest known colonies were established over three thousand years ago by the Phoenicians, the first great traders and navigators of the western world. As early as the seventh century B.C. they had travelled from their home ports in the Eastern Mediterranean and circumnavigated Africa. Carthage, the most important Phoenician colony, was established in 815 B.C. and soon grew to such an extent that it was necessary to incorporate large areas of land with the city in order to insure adequate food supply, marking the first step from trading post to colonial territory. Following the Phoenicians, the Greeks became the next important colonists, and although their settlements were essentially agricultural, mining was introduced for the first time. The colonies also served as trading centers for Greek merchants. Rome, which followed Greece as a colonial power, stressed commerce less than either the Greeks or the Phoenicians, and its colonies were often military outposts, famed for their military roads and fortifications. Roman colonies were forced to pay taxes to Rome in the form of foodstuffs and to assist in the maintenance of the Roman army.

With the gradual decline and fall of the Roman Empire, its colonies were abandoned and became independent. The Dark Ages, which followed, blacked out all interest in trading and much of the skill in navigation, and the world lived in a state of isolation. Shortly after the year 1,000 A.D., however, the crusades revived the spirit of travel and adventure and this coincided with the rise to power of Venice as a great trading center in the old tradition.

The birth of "Prince Henry the Navigator" in Portugal in the year 1394 marks the advent of the modern colonial period. Henry established a school of navigation, chart-making and cosmography in Portugal in 1410, which led to the rise of western seamanship. In 1492 Columbus made his historic voyage to America, and shortly afterwards, in 1498, Vasco de Gama sailed around the Cape of Good Hope and reached India. These two voyages, in effect,eliminated Venice as a great trading city and established western Europe as the commercial center of the world.

The Portuguese, the Spanish, the Dutch, the French and the English, became, in turn, the new colonial powers. Their primary interest was in precious metals, spices, furs and other riches which were readily available for trading. Great fortunes were made, but the most lucrative areas were soon cleared of easily accessible wealth and the colonial powers began a policy of the exploitation of the natural productive advantages of their colonies.

The British were the first to realize, about 1850, that by exporting machinery and capital, rather than finished goods, they could build up a better long-range market for their products. Reversing the whole current of world history, they began to develop overseas industrial, agricultural and engineering projects, not only in their colonies but in any country which showed a favorable opportunity. At the same time a more liberal attitude was adopted to the colonies and they were allowed to trade and negotiate with countries other than England. The growth of modern engineering practice, particularly

in the fields of transport and power, emphasized the advantages of the new British policy, and it was copied by the other colonial powers. The United States and Germany, although never prominent as colonial powers, also entered the field of international development. The inability of the Spanish and the Portuguese to compete successfully with the other nations in this new sphere of activities led to their decline as colonists, while, at the same time the British built up the greatest colonial empire in the world.

While overseas development was promoted primarily for gain and the interests of the underdeveloped areas were secondary, considerable benefits nevertheless accrued to the areas. More important, the direct contact with more elaborate standards of living led to a universal desire for higher local standards. The British, recognizing this demand, again pioneered in adopting a new and benevolent attitude towards overseas territories. By assuming an increased responsibility for the welfare of their empire they were influential in establishing new international standards in social services, tolerance, justice, freedom and commercial integrity.

Today, just one hundred years after the initiation of the modern era of overseas development in 1850, we are again confronted with a new, and this time, a revolutionary concept. This new concept stems from the fact that the majority of the people of the world, realizing that they live in areas with unsatisfactory standards of health and comfort, are no longer satisfied to wait for chance to improve their situation. They want more out of life than they presently enjoy and believe that it can be obtained by scientifically planned development of their countries' resources. They want the basic interests of the backward area to be the primary, not the secondary, criterion for development and are anxious to proceed at a much more rapid rate than has heretofore been achieved. They need outside technical skill, additional capital and cooperation, and they hope, with these, to achieve new standards in the social, economic and political field. It is in this new phase of development that the United States is planning to play an important role.

Engineering and Global Development

The growth of engineering has always been closely associated with overseas development. Some kind of engineering has existed ever since man first began to adapt his environment to suit his needs, and every century and every civilization has contributed to its present store of knowledge. The first engineers were craftsmen, both civil and military, and engineering knowledge was accumulated and preserved by the craft. "Even before the Christian era, engineers had perfected a surprising variety of techniques and were capable of constructing mines and quarries with shafts and tunnels of amazing length and depth, of building graded, crowned and bridged military roads, fortresses, public water supplies, sewerage systems, drainage and irrigation works. They were familiar with metallurgy, ceramics, the textile industry, metal and woodworking and the manufacture of agricultural tools."

The development of engineering from a craft to a profession has been slow and gradual and there is no clear division between the two. Even during the Dark Ages a gradual evolution was taking place with the discovery of such things as the water wheel. But the establishment of an engineering profession had to await the discovery of the printing press, and it appears that the transformation began shortly afterwards, following the development of the scientific method by Bacon and Galileo. The period of exploration and discovery which ensued provided a tremendous stimulus to science and engineering.

New problems were presented by travel and shipping and the increase in wealth which resulted from foreign trading stimulated investments, often in the manufacture of new technical products which were being developed. Watt's discovery of the steam engine was of particular importance as it led to the industrial revolution, which was, essentially, an engineering revolution based on the substitution of power driven machinery for hand manufacturing.

The founding of The Institution of Civil Engineers in London in the year 1826 marked the beginning of the modern epoch in the history of engineering, as the Institution was the first recognition of engineering as a profession. Its definition of engineering as "the art of directing the great sources of power in nature for the use and convenience of man" has remained unaltered as the most widely accepted definition in use today.

The growth of the profession since 1826 has been phenomenal and has culminated in the classification of our present period in history as the scientific, or engineering age. During this period engineering has become specialized and new branches such as mechanical, electrical, chemical, agricultural and public health engineering have been established. Besides the rapid progress which has been made in the use of scientific knowledge in the design, construction and manufacture of the thousands of new products which are now contributing to our health, comfort and convenience, engineers have played a prominent part in overseas development through such projects as the Canadian Pacific Railway, the Suez and Panama Canals, the Aswan Dam in Egypt, the Gezira Irrigation Project in the Sudan, the Middle East oil fields, International shipping and internation air transport.

Today, modern engineering makes it possible to alter completely the social and economic status of any area in the world. Assuming that adequate provision is made for health, education, nutrition and public understanding, and providing that the natural and human resources are available, the theoretical amount of improvement depends only on the resources at hand and the development desired. Engineers have a tremendous array of techniques and machinery available for use in this work, covering the fields of power, transport, communications, construction and manufacture.

Engineers are educated and trained in the efficient application of scientific principles for human use and convenience. This normally involves both design and construction. The engineering method is based on the use of the mathematical processes of analysis and synthesis, the two techniques which are essential in establishing a problem and in planning its solution. The practical application of this solution is the second and equally important phase of the engineering method, and it is this phase which is known to the public through the physical accomplishments which result. Hardy Cross has pointed out in his new book "Engineers and Ivory Towers" that engineers are not, however, only science practitioners. In order to be able to produce the goods and services which feature our present civilization it has not been sufficient to have scientific principles, it has been necessary to put them into practical use, and this latter task has required a sound knowledge of human relations, of economics and of accounting, as well as a basic knowledge of materials and design. Engineering is, therefore, to quote Professor Cross: "The glory of the adaptation of science to human needs . . . Engineers are not . . . primarily scientists. If they must be classified they may be considered more humanists than scientists . . . The material world is being transformed and transformed rapidly. But the transformation must not be attributed to pure science alone. An essential element, perhaps the most important element, is the correlating faculty of the engineer rather than the pure research faculty

of the scientist . . . Science standing alone contributes nothing to the welfare of mankind or to his illfare".

Public Health and Global Development

If there is any single factor that can be said to be most responsible for the present desire for development by the backward countries of the world, it is western medicine, especially preventive medicine. Although peoples may differ in their attitudes towards education, industrialization or modern agricultural methods, there is a universal desire for health. The provision of an adequate health program in planning not only satisfies this fundamental desire, but, in many parts of the world it is essential in order to create conditions under which development can take place. Here the health team, consisting of doctors, engineers and nurses form the pioneer corps which, through the elimination of health hazards, must prepare the area so that people may live and work safely.

There has been an increasing awareness, since the time of the great plagues, of the effect of environment in the origin and spread of disease and this has led, in turn, to the practise of environmental sanitation. More than one hundred years ago Edwin Chadwick in England and Lemuel Shattuck in the United States made strong recommendations for the use of engineering techniques in this field and since that time engineering has played an important role in public health work.

The United States has made a significant contribution to public health practice by recognizing the necessity for cooperation between a number of disciplines in the work in this field. Public health engineering was started in America as a result of this team approach, and it is considered to be one of the few engineering specialities which is uniquely American in its development. Because of previously established organizational procedure in many parts of the world, neither public health engineering nor the team approach to public health problems has been adopted on a world-wide basis. However, there is a growing awareness of its virtues and, therefore, an increasing utilization of the method.

With the establishment of The World Health Organization, health and health work have achieved added significance. According to the preamble to its constitution, health is now defined as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." This is obviously an idealistic interpretation and one which has not yet been attained for any large number of people anywhere in the world. It visualizes a healthy man as one who is not only free from disease but one who lives in a healthy environment and who has the necessary standard of living to maintain both health and comfort. This is a considerably different conception of health from the narrower one that is usually understood; that it is not considered revolutionary or unusual is attested by the fact that this definition has been agreed to by the eighty-two member-countries who form the organization.

The Problem

As has been said, we now have a variety of techniques which can be used in the development of backward areas. The success of such recent programs as the Amazon Valley Health Project in Brazil, malaria control in Greece and Italy, the Rockefeller Foundation Agricultural Project in Mexico and the rural rehabilitation demonstration in India are only a few of many similar

projects which could be used as examples of the use of some of these techniques. But, although we have been highly successful with individual projects, have we been able to perfect a general technique for over-all development? The evidence indicates that we have not and that we have yet to learn how to adapt our special methods to general problems. There are, on the contrary, many examples of failure in different parts of the world; abandoned monuments to our good intentions. These include some of our pre-war efforts in Greece, Puerto Rico and the Philippines. The difficulty appears to lie in our failure to approach the problem from a broad point of view, attempting instead to solve the problems of each country in terms of particular professional specialities. Marston Bates in his excellent book about the tropics called Where Winter Never Comes puts it this way: "No single point of attack, of course, will solve the problems of a human community. The development of universities (for example) is tied up with the development of education in general; the support of universities is tied up with the general problems of the economy of a country. In the pattern of human life everything is interrelated in complex, puzzling and often indirect ways".

We have become accustomed to speaking, in general terms, of the vicious cycle of poverty, disease and low standards of education. It is agreed that these are interdependent and it is believed that a marked improvement in any one of them should break the cycle and result in a general improvement in the standard of living. It is a serious error, however, to believe that this improvement comes about automatically and many technical assistance projects have failed because the program was based on this assumption. In order to provide anything except temporary humanitarian benefits a health program, for example, must be integrated with a general plan which makes provision for improvements in nutrition and education and which is geared with the general economy of the country. It produces no particular economic gain if the increased manpower made available by the health program does not have a productive outlet and this must normally be planned. The rule that overall planning is essential should be axiomatic but unfortunately it has not yet been generally accepted.

Professor Gunnar Myrdal has pointed out that there is a cumulative process which must also be considered in any consideration of general planning. The effect of increasing the standards in any one field tends to increase the combined standard, while conversely, a decrease in any one of the standards tends to lower the general standard, and these effects are cumulative. Lowering the standard of health tends to lower educational, nutritional and economic levels, which in turn have a tendency to still further lower the health standard. This is a positive factor and emphasizes the interrelation between the various disciplines in any development plan.

Until recent years no economic value was attached to the human resources of a country, nor were they included in natural resources surveys. This, according to Myrdal, is due to the fact that economists, the group most responsible in the past in establishing national and international policies, have had a tradition of "materialism." Through the efforts of public-health and social-science personnel, the economics of sickness and health have finally been recognized, but "it will take a very long time before our knowledge in this field has become so intensive and complete that it can be properly integrated into, and given its due place in, economics and social theory generally." However, it is now recognized that health can be made a positive economic factor, rather than a neutral or even a negative one, in development plans. Public health must be exploited on his basis if it is to have its rightful place in future national programs.

The Opportunity

If global development is to be successful it is evident that it must be a cooperative effort. While technical skill is required, success or failure is tied up with a whole complex of social, economic and political factors and an appreciation of these is as important as technical and administrative procedures. If, as Hardy Cross has said, the essential characteristic of the engineer is his "correlating faculty" it would appear that the development of backward areas would provide an important opportunity to the profession. This seems to me to be particularly true for public health engineers. Their education and training emphasizes the "public interest" and their relationship with the medical profession makes it possible for them to interpret and correlate health work with that of the other engineering professions.

But opportunity also implies responsibility. The atomic scientists, through their Bulletin of the Atomic Scientists, have been widely publicized for their recent attempts to think through the consequences of their research, and by their willingness to accept a share of the responsibility for its results. Engineers, on the other hand, during the past century have produced effects equally as startling and as revolutionary as that of the atomic bonb. In general, engineers have not recognized these consequences and have not been willing to take responsibility for them. As a result, they have tended to "become a part of the machinery which has created this situation rather than masters of it".

If the historians are right in their belief that the present interest in the social and economic development of the backward areas of the world is of historic significance, we are faced at the present time with a serious challenge - can we, by the utilization of modern technology, provide the initiative for such development in the large areas of the world dependent on us for inspiration and guidance and can we get it successfully under way? This is a challenge which is of particular interest to engineers. As progress in environmental sanitation is fundamental and must usually be of a pioneer nature in order to provide the ground work for subsequent progress, public health engineers are particularly concerned in this problem. Being aware of the problem is important but, of course, is only a first step and it is not enough merely to express a desire to cooperate. While public health engineering training has proved to be sound, American techniques are not always capable of adoption, without a considerable amount of modification, in those parts of the world in which we are now concerned. Research and investigation is necessary to develop new and cheaper techniques. A willingness to work outside of the United States, an understanding of the social, economic and political problems of development and an ability to adapt organizations and professional duties to the administrational set-up which is found are all important necessities.

Toynbee, one of our most widely accepted historians, states that successful civilizations have developed as a result of a successful response to an important challenge. The public health engineering profession must share an important part of the responsibility with regard to the present challenge which faces us, and our future as a professional body may depend on the quality of the response which we are able to make.